

PATENT COOPERATION TREATY
PCT
INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P61583PC00	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/NL 03/00634	International filing date (day/month/year) 12.09.2003	Priority date (day/month/year) 13.09.2002	
International Patent Classification (IPC) or both national classification and IPC G01B9/02			
Applicant NEDERLANDSE ORGANISATIE VOOR TOEGEPAST- ...et al.			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 7 sheets.</p> <p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the opinion II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application 			
Date of submission of the demand 13.04.2004	Date of completion of this report 14.12.2004		
Name and mailing address of the International preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 	Authorized Officer Arca, G Telephone No. +31 70 340-2773 		

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No.

PCT/NL 03/00634

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-14 as originally filed

Claims, Numbers

2-12, 14-22 received on 15.04.2004 with letter of 15.04.2004
1, 13 filed with telefax on 08.10.2004

Drawings, Sheets

1/5-5/5 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the International application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:
- the drawings, sheets:

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International application No.

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5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-22
	No: Claims	
Inventive step (IS)	Yes: Claims	1-22
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-22
	No: Claims	

2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NL 03/00634

Re Item V**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Reference is made to the following document:

- D1: HEDSER VAN BRUG: "Temporal phase unwrapping and its application in shearography systems" APPLIED OPTICS, vol. 37, no. 28, 1 October 1998 (1998-10-01), pages 6701-6706, XP002244333

Novelty

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document):
a shearography system for measuring surface shapes, comprising a two-camera polarization phase-stepped system (page 6705, fig. 6 and 7).

The subject-matter of claim 1 differs from this known interferometer in that it comprises an optical phase filter placed in one of the split beams.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

Inventive step

The problem to be solved by the present invention may be regarded as how to generate a predetermined phase plane for a single of the split beams.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: document D1 does not suggest such a modification to the shearography system of D1. Also the other document found during the search does not contain any teaching in this sense.

The consideration on novelty and inventive step given above for method claim 1 likewise apply, *mutatis mutandis*, to the corresponding apparatus claim 13.

Claims 2-12 and 14-22 are dependent on claims 1 and 13 respectively and as such also meet the requirements of the PCT with respect to novelty and inventive step.

EPO - DG 1

15. 04. 2004

New claims

(71)

1. A method for measuring a contour variation of a measuring area on an object, comprising the steps of:
 - irradiating the measuring area with a light beam, while reflection or transmission of the beam occurs;
 - splitting the transmitted or reflected beam;
 - varying the phase of the split beams relative to each other, such that the differential phase is kept within the range of 2 pi;
 - combining the split beams with each other and observing a fringe pattern which represents a differential phase between the split beams;
 - calculating an optical path length difference from the differential phase; and
 - relating the optical path length difference to the contour variation of the object, characterized in that the phase is varied by placing an optical phase filter in one of the split beams for generating a predetermined phase plane.
- 15 2. A method according to claim 1, characterized in that the phase of the split beams is varied by carrying out a relative movement of the beam and the measuring area such that the form of the measuring area changes.
- 20 3. A method according to claim 1 or 2, characterized in that the form of the measuring area changes under the influence of a material-adding or material-removing operation.
- 25 4. A method according to at least one of the preceding claims, characterized in that the method is repeatedly used for measuring phase changes greater than 2 pi.

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5. A method according to claim 1, characterized in that the phase filter is a pin hole the size of the diffraction spot, so that the phase plane is a zero front.
- 5 6. A method according to at least one of the preceding claims, characterized in that the beam has a diameter such that at least two positions, varying in height in a measuring area are exposed; which method comprises the steps of:
 - shifting the measuring beam relative to itself along the connecting line between said positions so that a differential phase between the shifted beams lies within a range of 2π ; and
 - calculating, by integrating the differential phase, an optical path length difference related to the contour variation of the object.
- 10 7. A method according to claim 7, characterized in that the method comprises the step of displacing a split beam by means of a rotating mirror; projecting the split beams on a lens, which beams, as a result of the displacement, run at an angle relative to each other; and observing, in a focal plane of the lens, a fringe pattern resulting from a shift of the beams which corresponds to the angular displacement of the rotating mirror.
- 20 8. A method according to claim 8, characterized in that the degree of shearing is determined by the slope of the contour variation.
- 25 9. A method according to at least one of the preceding claims, characterized in that the measuring beam is a parallel light beam of a relatively small diameter, wherein the measuring area possesses a dimension smaller than the diameter of the measuring beam.
- 30 10. A method according to at least one of the preceding claims, characterized in that the reflected measuring beam is a diffuse light beam.

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11. A method according to claim 11, characterized in that the measuring beam is a homogeneous, parallel light beam, wherein the measuring surface is provided with a mat layer, such that the reflected beam is a diffuse light beam.

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12. A method according to claim 11, characterized in that the measuring beam is reflected on a smooth surface, wherein the measuring beam is a diffuse light beam.

10 13. An apparatus for measuring a contour variation of a measuring area on an object, comprising:

- a light source for providing a light beam for irradiating a measuring area;
 - a holder for positioning the object relative to the light source;
 - a beam splitting member for splitting the transmitted or reflected beam;
 - a phase influencing member for setting a phase difference between the split beams;
 - a beam combining member for combining the split beams;
 - an observation member for observing a fringe pattern representing a differential phase between the split beams; and
 - a processor for calculating an optical path length difference from the differential phase and for relating the optical path length difference to the contour variation of the object;
- characterized in that the phase influencing member comprises an optical phase filter for generating a predetermined phase plane.

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14. An apparatus according to claim 14, characterized in that the holder is adapted for carrying out a relative movement of the beam and the object.

15. An apparatus according to claim 14 or 15, characterized in that the apparatus is provided with means for changing the form of the object by a material-adding or material-removing operation.
- 5 16. An apparatus according to claim 13, characterized in that the phase filter is a pin hole, so that the phase plane is a zero front.
- 10 17. An apparatus according to at least one of the preceding claims, characterized in that the beam possesses such a diameter that at least two positions varying in height in a measuring area are exposed; wherein the phase-influencing member comprises means for shifting the measuring beam relative to itself in an adjustable manner along the connecting line between said positions.
- 15 18. An apparatus according to at least one of the preceding claims, characterized in that the phase-influencing member comprises a rotating mirror for displacing the split beam at an angle, wherein the beam-combining member combines the split beams and projects them, mutually running at an angle, on a lens, wherein the observation member is arranged in a focal plane of the lens, so that a fringe pattern is observed resulting from a shifting of the beams corresponding to the angular displacement of the rotating mirror.
- 20 19. An apparatus according to at least one of the preceding claims, characterized in that the measuring beam is a parallel light beam of a relatively small diameter, wherein the measuring area possesses a dimension smaller than the diameter of the measuring beam.
- 25 20. An apparatus according to at least one of the preceding claims, characterized in that the reflected measuring beam is a diffuse light beam.

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21. An apparatus according to at least one of the preceding claims, characterized in that the measuring beam is a homogeneous, parallel light beam, wherein the measuring surface is provided with a mat layer, such that the reflected beam is a diffuse light beam.

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22. An apparatus according to at least one of the preceding claims, characterized in that the measuring beam is reflected on a smooth surface, wherein the measuring beam is a diffuse light beam.

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Int. pat. appln. no. PCT/NL2003/000634
 Our letter of October 8, 2004

New claims

1. A method for measuring a contour variation of a measuring area on an object, comprising the steps of:
 - irradiating the measuring area with a light beam, while reflection or transmission of the beam occurs;
 - 5 - splitting the transmitted or reflected beam;
 - varying the phase of the split beams relative to each other, such that the differential phase is kept within the range of 2π ;
 - combining the split beams with each other and observing a fringe pattern which represents a differential phase between the split beams;
 - 10 - calculating an optical path length difference from the differential phase;
 - and
 - relating the optical path length difference to the contour variation of the object, characterized in that the phase is varied by placing, in only one of said split beams, -an optical phase filter for generating a predetermined phase plane.
13. An apparatus for measuring a contour variation of a measuring area on an object, comprising:
 - a light source for providing a light beam for irradiating a measuring area;
 - 20 - a holder for positioning the object relative to the light source;
 - a beam splitting member for splitting the transmitted or reflected beam;
 - a phase influencing member for setting a phase difference between the split beams;
 - 25 - a beam combining member for combining the split beams;
 - an observation member for observing a fringe pattern representing a differential phase between the split beams; and

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- a processor for calculating an optical path length difference from the differential phase and for relating the optical path length difference to the contour variation of the object;
characterized in that, in only one of said split beams, the phase influencing member comprises an optical phase filter for generating a predetermined phase plane.
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